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SASKATCHEWAN'S DRYLAND SALINITY CONTROL PROGRAM

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Saskatchewan farmers and agricultural extension workers have through the years expressed growing concern over an increasing soil salinity problem. Yet while an increasing salinity problem seems apparent, there hasn't been reliable documentation of its extent or increase. This inadequacy led, in 1974, to a decision by the provincial government to establish a soil salinity policy with a $28,000. budget.

The first step taken to institute the salinity policy was to assemble provincial, federal and university personnel at a salinity workshop in Saskatoon in May 1974. The most pressing concern expressed at the workshop was the need for a reliable estimate of the extent of soil salinity in Saskatchewan and especially its increase over time.

The main thrust of the salinity program in the early stages was the initiation of a computer study of assessment data for selected areas in the province. One such area was township 13, Range 25 West of the 2nd Meridian in the Rural Municipality of Baildon southeast of Moose Jaw. Computer print-out here showed considerable increase in salinty comparing the 1970 assessment with that of 1950 (See figures 1 and 2).

With computer print-out information to guide, salinity demonstration sites were then selected from lists of farmer locations supplied by extension agents. Potentially acceptable sites were later surveyed for topography and soil type. After a detailed assessment of all pertinent data, including complete analysis of deep core soil samples, the sites were either accepted or rejected for demonstration purposes.

Following the second and third salinity workshops held in Saskatoon in December 1974 and April 1975, eight research demonstration sites were selected for field study during the 1975 season-- four in the southwest region and four in the northwest region of the province. (See figure 3). Of these sites one is in the Brown soil zone, five are in the Dark Brown soil zone and two are in the Black soil zone. Preliminary plans are to develop seven

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new salinity study sites in 1976, four in the Brown soil zone, two in the Dark Brown soil zone and one in the Black soil zone (See figure 3). It is intended eventually to increase the number of salinity research demonstration sites to twenty-five, with additional locations being selected from the more moist southeastern and eastern regions of the province.

At the spring workshop we were able to formalize the 1975 experimental cropping design for the eight salinity study sites. I have selected one such site, the Forman site from the Dark Brown soil zone south of Moose Jaw, to illustrate the approach we in Saskatchewan are taking to identify and hopefully overcome a saline seep problem (See figures 4 to 7 and Tables 1 & 2).

Precise location of the Forman salinity site is identified on the soil survey maps of figures 4 and 5. Note, too, the location of other demonstration sites under study in this area southeast of Moose Jaw. The entire area is influenced topographically by the Cactus Hills of the Missouri Couteau upland to the west.

The detailed soil survey of the Forman site as shown in figure 7, indicates a predominately clay loam to clay soil material with high salt accumulation in clay areas. There are, however, fine sandy loam soils in the drainage ways and varying depths of sandy materials occuring north and upslope of the saline areas. For more precise soils and landscape information of the Forman site refer appendix A. For detailed soil analysis of deep core samples see tables 1 & 2.

While surface drainage on the site appears adequate there could be some temporary surface ponding on the severe saline spots during spring runoff and after heavy rains. The surface water coming out of the hills to the north may carry more than average amounts of salts, which, over a period of years of deposition through evaporation, adds considerably to the saline buildup in ponded areas.

Groundwater undoubtedly also contributes to the saline problem. Rostad and Moore suggest in their report (appendix A) the possibility that water infiltrates in the sand above and discharges downslope. The Cactus Hills to the north and west could be providing the hydraulic head necessary to cause discharge of saline groundwater. Summerfallowed fields in the cultivated area of the hills above likely contribute to the recharge system as well.

In attempting corrective measures for the saline seep problem, the first step taken was to seed alfalfa and tall wheatgrass as interceptor strips above the highly salinized discharge areas. (See figure 8). The 25 acre tall wheatgrass strip was seeded in the fall of 1974 while the 20 acre alfalfa strip was seeded above the grass in the spring of 1975. Excellent forage stands have been achieved.

The remaining 60 acres of the demonstration area, below the forage strips, was seeded to barley in 1975 as a soil salinity indicator crop. In 1976 it is intended that this acreage be divided into three 20 acre strips to compare various rotation practises. (Figure 8). One strip will be in a standard summerfallow crop rotation, one will be in continuous crop using straight grain and the third strip will be in continuous crop using sweet clover in the grain rotation. By comparing these rotations over a period of years it is hoped that our recommendations for handling saline soils can be strengthened.

Similar research and cropping designs are being applied on the other salinity demonstration sites in the province. As a further means of measuring change through cropping, nests of observation wells are to be installed on three sites to monitor water quality and water table movement. Three wells',using perforated plastic tubing, drilled to depths of 5, 10 and 20 feet, constitute a nest. Three such nests, located as indicated for the Forman site in figure 7, will be used on the demonstration sites.

Also, in 1975, replicated small plots of annual crops were seeded on three demonstration sites to compare crop tolerance to salinity (See figure 9, and Table 3). Results have been somewhat different than expected. For example, sunflowers showed up remarkably well--they started strong and continued healthy throughout the season. Barley and oats started strong, too, but while oats kept healthy to maturity, barley seemed to suffer sufficiently from the heat and drought of July to never reach its full potential. Sugar beets weren't impressive at first but matured well. Pitic wheat seems to offer possibilities, too, but Napayo and Macoun wheats, buckwheat, lentils, rapeseed, mustard and flax did poorly under the conditions of this experiment. A number of years experience will be required to fully appraise crop tolerance aspect as well as the myriad of other aspects of the salinity program.

In conclusion, I can only reiterate that we have really only started on a dryland salinity control program. I have outlined, in this paper, some of the highlights of the approach we are taking. The years ahead will reveal the merits of the co-ordinated research-demonstration program being undertaken.

Fig. 1

ALK. CONDEMNATION FOR TOWNSHIP 13 RANGE 25 WEST OF 2

50 :155	160 :	:	:	:	:
7 :3 8	5 5 : 4	:	:	:	:
85 : 130	159: 160	:	:	:	:
:	160 :95	25 :	:	:	:
3 : 6	6 5 :4 5	7 4 : 3	:	1 :	3 :
80 : 25	159: 160	55 : 50	:	100:	155:
:45	:140	110 :	:	:	:
:6	3 :2 6	3 5 : 3	:	:	:
:	155: 155	50 : 40	:	:	:
:	80 :130	100 :50	20 :	:	:
: 3	6 2 :4 5	4 5 :2 3	6 3 :	:	:
: 35	75 : 100	45 : 70	45 :	:	:
:	:	:	:	:	:
:	: 5	:	:	3 :	:
:	: 15	:	:	150:	:
:	:	:	:	:	:
:10	75	25	:	:	:
:6 2	5 6	3 3	:	:	:
: 105	80	100	:	:	:
:	:	:155	:	:	:
: 2	: 4	:4	:	:	:
: 85	: 25	:	:	:	:
:	:	:	:	:	3 :
:	:	:	:	:	155:
:	:	:	:	:	:
7 :	:	:	:	3 : 2	1 :
50 :	:	:	:	60 : 80	145:
:	:	:	:	:	:
3 : 4	:	5 : 4	: 2	2 : 4	2 :
30 : 65	:	20 : 15	: 35	150: 150	150:
:	20 :90	:	:	:	:
4 : 4	7 8 :1 10	6 :	: 2	8 : 3	2 :
20 : 20	25 : 15	40 :	: 20	115: 90	155:

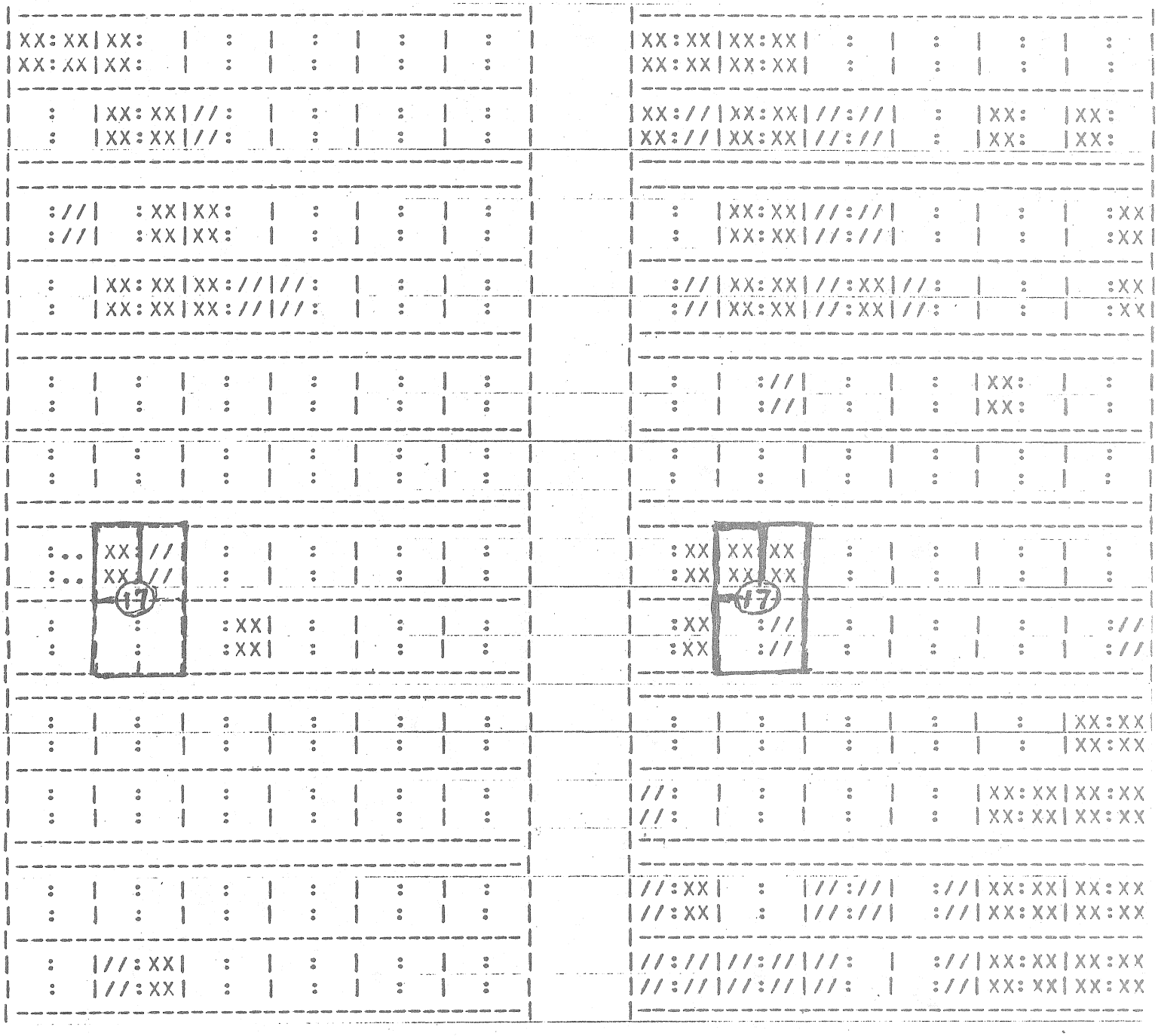
KEY: Refer NW17 upper left hand numbers $\frac{75}{5}$ indicate that, as of the 1950 assessment, 75 acres have an alkali condemnation of 5. Lower right hand numbers $\frac{6}{80}$ indicate that, as of the 1970 assessment, 80 acres have an alkali condemnation of 6.

Fig. 2

GREY SCALE FOR TOWNSHIP 13 RANGE 25 WEST OF 2

YEAR OF FIRST ASSESSMENT 50

YEAR OF SECOND ASSESSMENT 70



KEY:

XX
XX — 60 to 160 acres showing salinity

// — 15 to 59 acres showing salinity
//

.. — 1 to 14 acres showing salinity
..

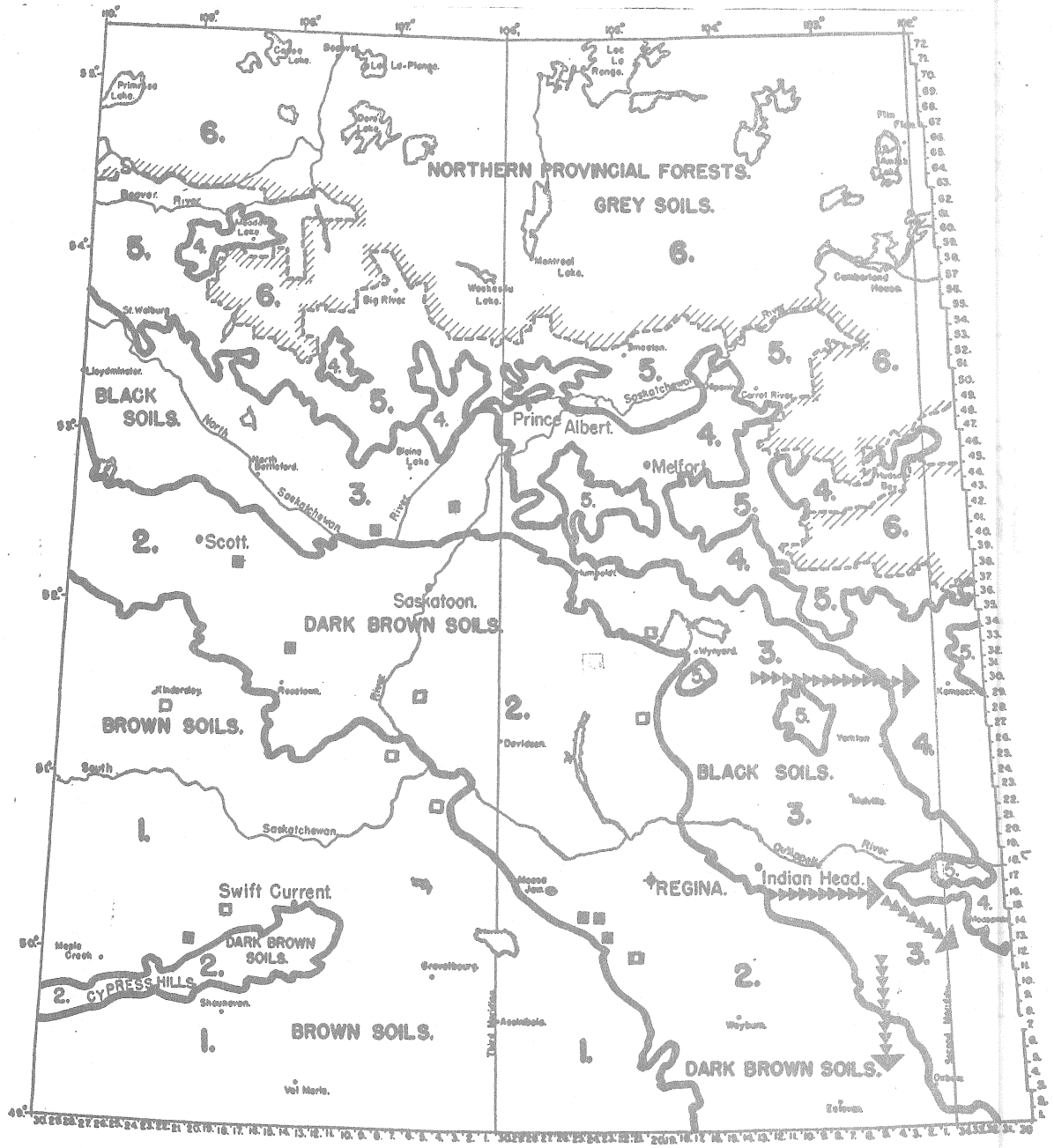
Fig. 3

SASKATCHEWAN SALINITY PROGRAM
RESEARCH-DEMONSTRATION SITES

■-1975 site locations

□-1976 proposed site locations

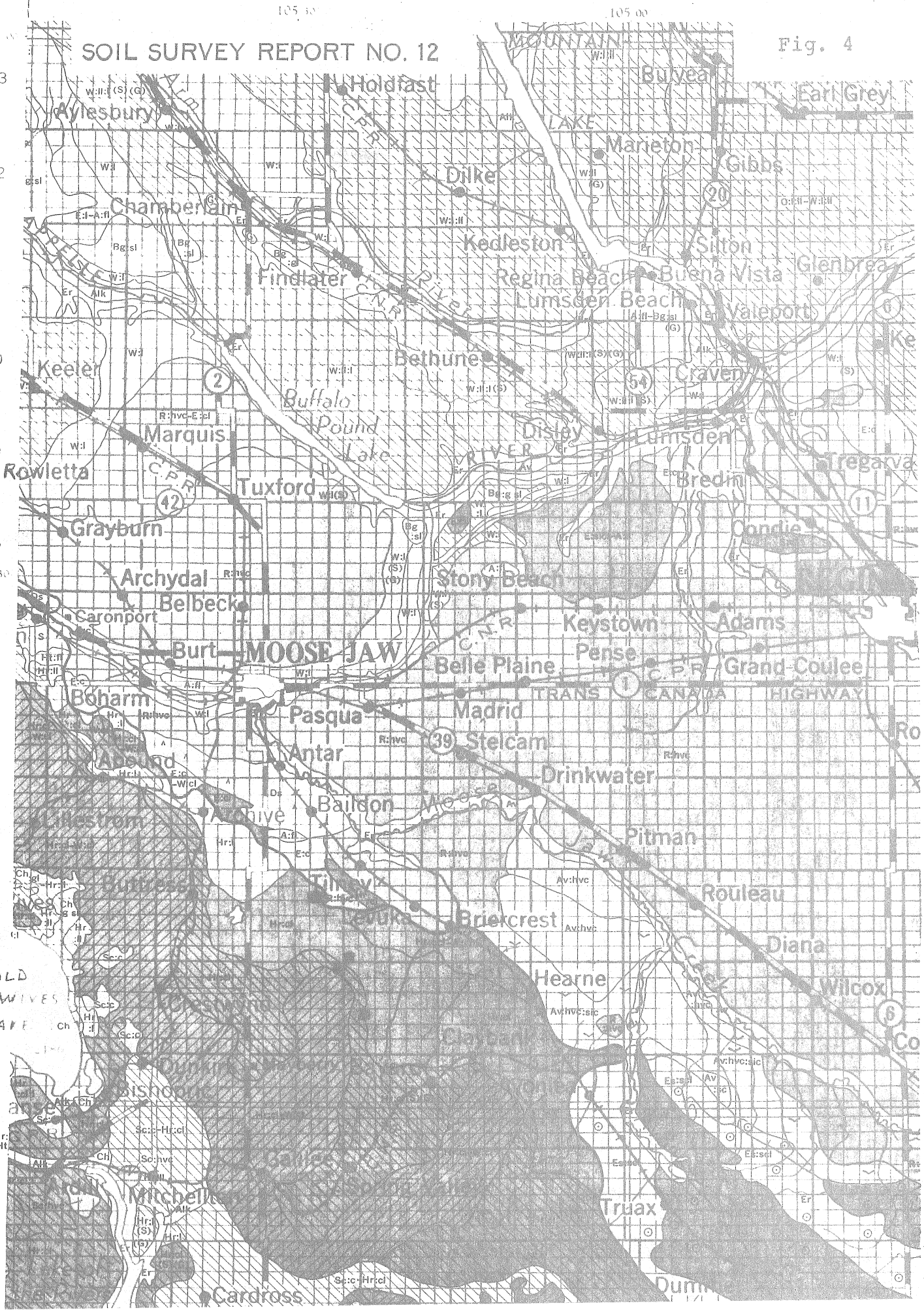
▸▸▶-areas for future site locations



—LEGEND—

1. Brown Soils of the open prairie, the most arid section of the province. Wide variations in crop yields and frequent severe droughts.
2. Dark Brown Soils of the prairie, less arid than the Brown Soils. Variable crop yields but less frequent severe droughts.
3. Black Soils of the parkland. Better moisture conditions and better average yields than on the prairie. Severe droughts rarely experienced.
4. Thick Black and Greyish Black Soils of the parkland-forest belt. Good moisture conditions and high crop yields.
5. Grey Wooded Soils of the forest region. Moisture conditions good, but soils are low in organic matter and general fertility.
6. Grey Soils and Muskeg of the unsettled Northern Provincial Forest. - - - - - - Boundary of Northern Provincial Forest Reserves.

Fig. 4


R.28
27
26
25
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105.30
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Tp.23
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17
16
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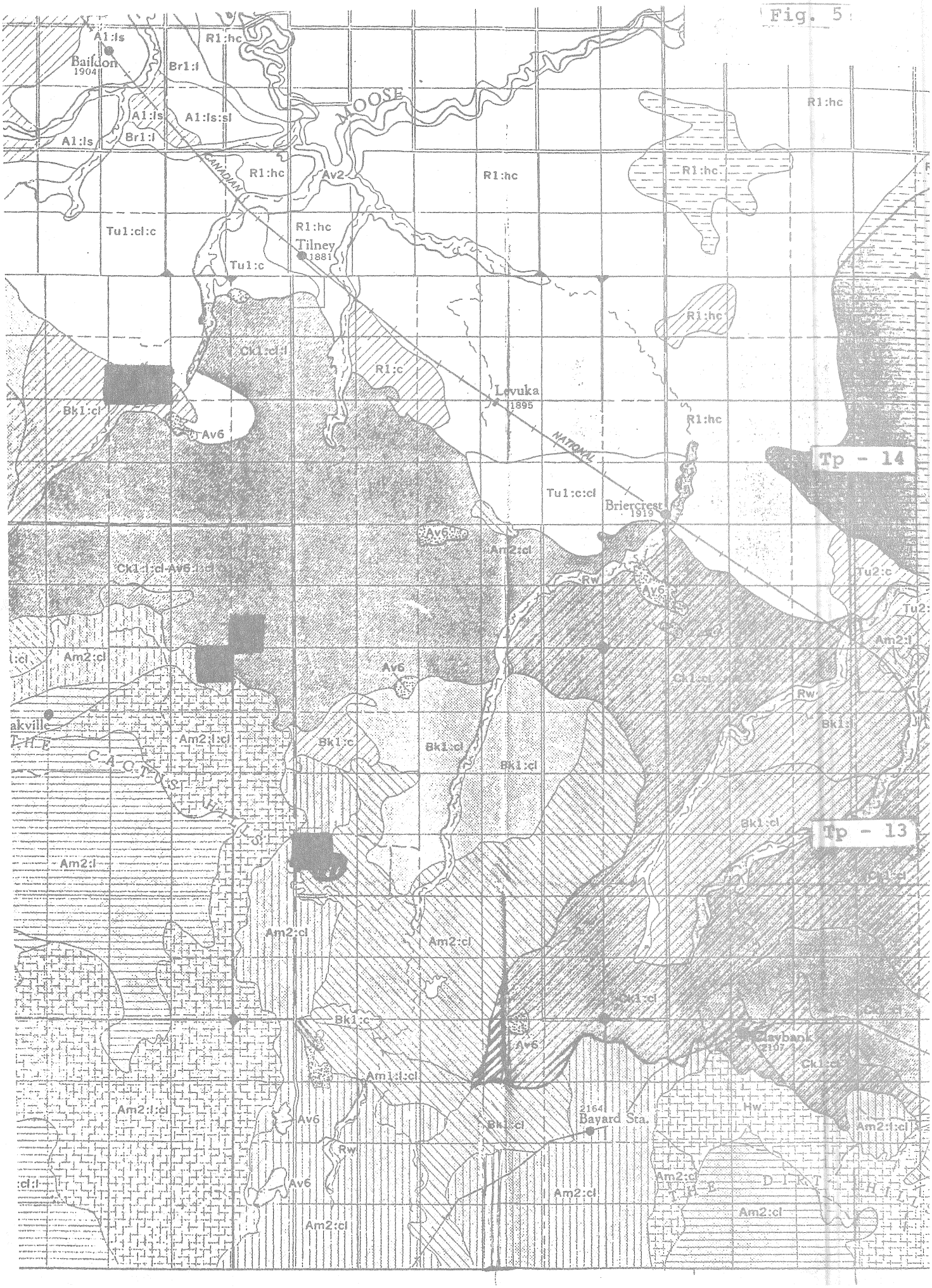
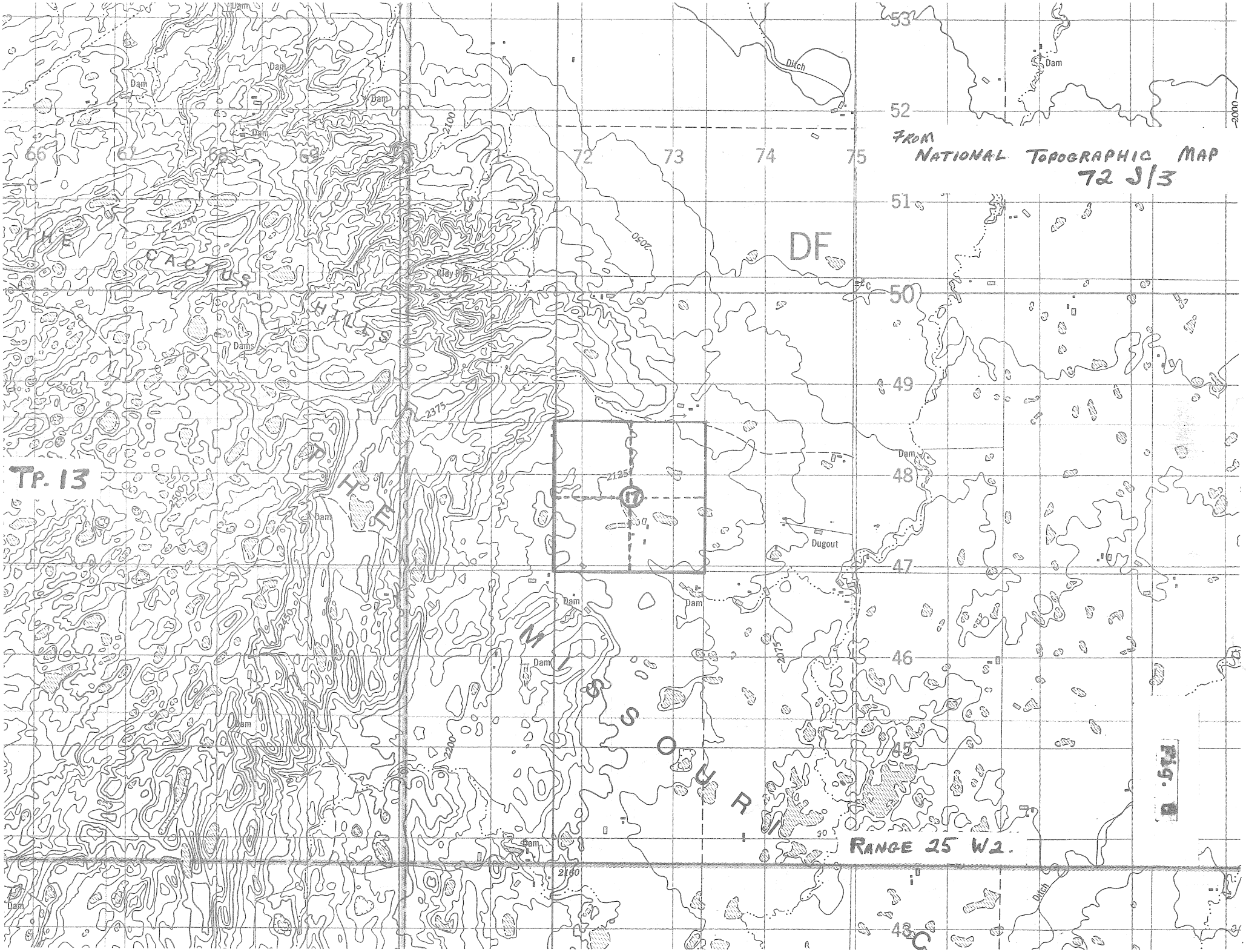
14
13
12
11
10
MOUNTAIN
Holdfast
Aylesbury
Buivea
Earl Grey
LAKE
Marieton
Gibbs
Dilke
Chamberlain
Kedleston
Silton
Findlater
Regina Beach
Buena Vista
Glenbrea
Lumsden Beach
Valeport
Bethune
Craven
Keeler
Buffalo Pound Lake
Disley
Lumsden
Marquis
Rowletta
Tuxford
Bredin
Tregarva
Grayburn
Condie
Archydal
Belbeck
Stony Beach
Caronport
Keystown
Adams
Burt
MOOSE JAW
Belle Plaine
Pense
Grand Coulee
TRANS CANADA HIGHWAY
Boharm
Pasqua
Madrid
Stelcam
Antar
Drinkwater
Baildon
Pitman
Rouleau
Briercrest
Diana
Hearne
Wilcox
OLD WIVES LAKE
Truax
Mitchell
Cardross
C.N.R.
C.P.R.
RIVER

Fig. 5


Baildon
1904
Tilney
1881
Levuka
1895
Briercrest
1919
Claybank
2197
2164
Bayard Sta.
MOOSE
CANADIAN
NATIONAL
Tp - 14
Tp - 13
THE CATS HILLS
THE DRY HILLS
A1:ls
A1:ls:sl
Br1:l
R1:hc
R1:c
Av2
Tu1:cl:c
Tu1:c
Tu1:c:cl
Ck1:cl:l
Bk1:cl
Bk1:c
Av6
Am2:cl
Am2:l:cl
Am1:l:cl
Ck1:cl-Av6:hc
Rw
Hw
Tu2:c
Ck1:cl
Ck1:c


FROM NATIONAL TOPOGRAPHIC MAP 72 J/3
THE CACTUS FLATS
SOUTH
MISSOURI
DF
Dugout
Ditch
Clay Pit
Dam
Dams
TP. 13
RANGE 25 W2.
Fig. 1
53
52
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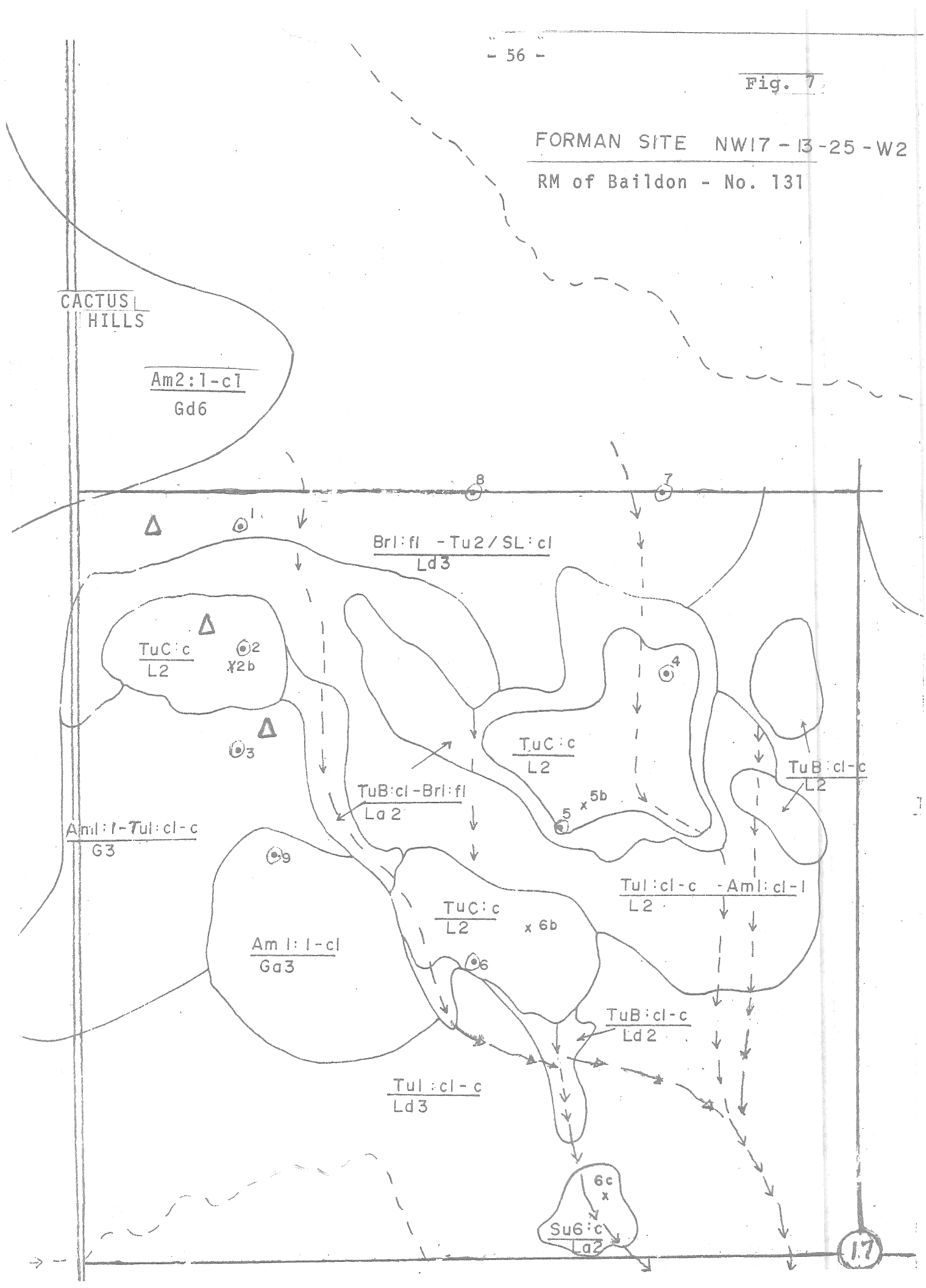
2100
2050
2375
2250
2125
2075
2200
2150
2000

Fig. 7

FORMAN SITE NW17 - 13 - 25 - W2

RM of Baildon - No. 131



LEGEND FOR FIGURE 7

ASSOCIATIONS AND MAPPING UNITS

Tuxford Association

Tul - Dominantly Dark Brown Solonetz series with significant Dark Brown Solod series

TuB - Dominantly moderately saline phases of the Dark Brown Solonetz series

TuC - Dominantly strongly saline phases of the Dark Brown Solonetz and Orthic Dark Brown series

Bradwell Association

Brl - Dominantly Orthic Dark Brown series

Amulet Association

Aml - Dominantly Orthic Dark Brown series

Am2 - Dominantly Orthic Dark Brown Series and significant Orthic Regosol series and Gleysols

Sutherland Association

Sul - Dominantly Orthic Dark Brown series

Su6 - Dominantly carbonated and/or saline Chernozemic Dark Brown Soils

SEQUENCE OF MAP SYMBOLS

TuB-c - Tu Tuxford Association
B Map unit
c Texture, clay

TOPOGRAPHY

L2 - Unpatterened lacustrine plain (0.5 - 2% slope)

La2- Knoll and depression lacustrine plain (0.5 - 2% slope)

Ld3- Dissected lacustrine plain (2 - 5% slope)

G3 - Unpatterened glacial till plain (2 - 5% slope)

Ga3- Knoll and depression glacial till plain (2 - 5% slope)

Gd6- Very steeply sloping & strongly dissected glacial till (over 16% slope)

OTHER MAP SYMBOLS

⊙ - Soil sampled by deep augering

X - Shallow soil sample

Stream

Δ -Nest of observation wells

SASKATCHEWAN SOIL TESTING LABORATORY

TABLE 1

SALINITY ANALYSIS DATA — FORMAN SITE

YOUR SAMPLE NUMBER		PERCENT SATURATION	PH	CONDUCTIVITY MMHOS/CM	WATER SOLUBLE IONS (PPM) NA	CA	MG	K	CL	SO4	SAR
SP 1	0-1 ft	66	7.1	2.8	81.0	305.0	255.0	20.0	10.0	1360.0	0.8
SP 2	1-2 ft	74	7.8	1.1	91.0	45.0	55.0	14.0	10.0	200.0	2.2
SP 3	2-3 ft	72	8.1	1.3	207.0	15.0	35.0	18.0	12.0	300.0	6.7
SP 4	3-4 ft	28	8.0	1.5	245.0	25.0	45.0	21.0	23.0	375.0	6.8
SP 5	4-5 ft	26	7.9	2.6	380.0	50.0	115.0	27.0	37.0	720.0	6.8
SP 6	5-6 ft	42	7.7	6.6	745.0	430.0	480.0	44.0	81.0	2700.0	5.9
SP 7	6-7 ft	47	7.7	7.2	865.0	430.0	550.0	44.0	114.0	3200.0	6.5
SP 8	7-8 ft	40	7.8	6.8	800.0	430.0	465.0	44.0	105.0	2520.0	6.4
SP 9	8-9 ft	46	7.6	6.7	800.0	405.0	460.0	44.0	98.0	2300.0	6.5
SP 10	9-10 ft	61	7.6	6.9	840.0	435.0	435.0	52.0	80.0	2380.0	6.8
SP 11	10-11 ft	60	7.6	6.8	835.0	445.0	420.0	53.0	74.0	3400.0	6.8
SP 12	11-12 ft	60	7.5	6.8	850.0	450.0	410.0	54.0	71.0	3600.0	7.0
SP 13	12-13 ft	59	7.3	7.0	355.0	445.0	420.0	55.0	85.0	3200.0	2.9
SP 14	13-14 ft	63	7.3	6.8	565.0	450.0	410.0	57.0	79.0	3220.0	4.6
SP 15	14-15 ft	63	7.1	6.6	1025.0	450.0	390.0	58.0	70.0	3240.0	8.5
SP 16	0-1 ft	74	7.8	19.0	1230.0	450.0	1400.0	54.0	840.0	20000.0	6.4
SP 17	2 ft	84	7.9	17.7	1300.0	430.0	1450.0	37.0	630.0	7600.0	6.7
SP 18	3 ft	89	7.9	15.8	1230.0	420.0	1300.0	35.0	530.0	6000.0	6.7
SP 19	4 ft	94	7.7	14.2	1155.0	435.0	1350.0	42.0	460.0	6400.0	6.2
SP 20	5 ft	74	7.8	14.2	830.0	415.0	1300.0	49.0	470.0	7000.0	4.5
SP 21	6 ft	74	7.8	11.8	1075.0	415.0	950.0	44.0	370.0	5400.0	6.7
SP 22	7 ft	77	7.8	10.9	1630.0	420.0	850.0	42.0	187.0	5400.0	10.5
SP 23	8 ft	73	7.7	10.8	1945.0	415.0	850.0	44.0	174.0	5000.0	12.6
SP 24	9 ft	69	7.6	12.3	1970.0	425.0	1000.0	48.0	400.0	3600.0	11.9
SP 25	10 ft	60	7.6	11.1	1480.0	410.0	850.0	43.0	185.0	4400.0	9.6
SP 26	11 ft	61	7.6	9.4	1560.0	120.0	650.0	35.0	340.0	2800.0	12.4
SP 27	12 ft	61	7.5	11.2	1335.0	425.0	950.0	44.0	360.0	5600.0	8.2
SP 28	0-1 ft	16	7.2	0.8	29.0	60.0	30.0	10.0	14.0	65.0	0.8
SP 29	2 ft	38	7.6	0.9	36.0	80.0	40.0	11.0	20.0	115.0	0.8
SP 30	3 ft	97	7.7	0.7	83.0	20.0	20.0	14.0	12.0	65.0	3.1
SP 31	4 ft	94	8.0	0.8	157.0	5.0	10.0	6.0	14.0	55.0	9.3
SP 32	5 ft	99	8.0	1.1	219.0	5.0	10.0	6.0	37.0	95.0	13.0
SP 33	6 ft	13	8.0	1.8	990.0	15.0	25.0	9.0	66.0	280.0	36.4
SP 34	7 ft	07	7.9	3.2	990.0	30.0	100.0	15.0	116.0	1280.0	19.5
SP 35	8 ft	80	7.6	7.9	1030.0	455.0	550.0	34.0	170.0	3200.0	7.7
SP 36	9 ft	60	7.5	9.1	1280.0	455.0	700.0	36.0	370.0	2600.0	8.8
SP 37	10 ft	59	7.5	9.6	5700.0	445.0	750.0	37.0	400.0	3000.0	38.3
			7.2	9.1	895.0	455.0	650.0	38.0	440.0	2400.0	6.3

Forman #1 — saturated water @ 5-7 ft

Forman #2 — water @ 1-8 ft

Forman #3 — No water

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TABLE 1

SASKATCHEWAN SOIL TESTING LABORATORY — TABLE 2

SALINITY ANALYSIS DATA — FORMAN SITE

YOUR SAMPLE NUMBER		PERCENT SATURATION		PH	CONDUCTIVITY MMHOS/CM	WATER SOLUBLE IONS (PPM) NA	CA	MG	K	CL	SO4	SAR
Hole #4 Forman												
SP 41	0 to 1ft	70		7.1	7.7	4450.0	480.0	455.0	44.0	83.0	3000.0	34.9
SP 42	2ft	58		7.5	10.2	3850.0	425.0	600.0	29.0	160.0	3200.0	28.2
SP 43	3ft	60		7.7	11.8	3300.0	420.0	800.0	27.0	187.0	5000.0	21.8
SP 44	4ft	60		7.7	11.9	2375.0	400.0	800.0	28.0	182.0	4020.0	15.8
SP 45	5ft	61		7.6	9.6	2320.0	415.0	600.0	39.0	123.0	3400.0	17.0
SP 46	6ft	61		7.7	9.9	1925.0	370.0	600.0	35.0	120.0	3400.0	14.4
SP 47	7ft	58	saturated @ water 6-9ft	7.8	8.3	1760.0	200.0	465.0	37.0	109.0	2800.0	15.6
SP 48	8ft	64		7.7	6.6	1730.0	110.0	370.0	41.0	87.0	1900.0	17.8
SP 49	9ft	65		7.7	6.6	2055.0	145.0	395.0	44.0	84.0	2680.0	20.1
SP 50	9-12 ft	80		7.5	7.2	1815.0	210.0	455.0	49.0	76.0	2860.0	16.1
SP 51	12-15 ft	64		7.5	9.1	1635.0	430.0	700.0	51.0	104.0	7400.0	11.3
Hole #6 Forman												
SP 52	0 to 1ft	76		7.5	24.3	1810.0	465.0	2250.0	44.0	1030.0	9000.0	7.7
SP 53	2ft	88		8.1	17.7	4550.0	435.0	1350.0	16.0	580.0	17200.0	24.3
SP 54	3ft	80		8.1	19.2	4400.0	435.0	1650.0	19.0	550.0	17200.0	21.6
SP 55	4ft	94		7.8	18.0	3900.0	445.0	1450.0	25.0	480.0	16000.0	20.2
SP 56	5ft	00		7.8	14.2	3150.0	430.0	1000.0	27.0	360.0	11400.0	19.0
SP 57	6ft	95		7.9	14.2	2505.0	430.0	1000.0	27.0	360.0	11000.0	15.1
SP 58	7ft	73		7.7	13.4	2285.0	440.0	2650.0	28.0	320.0	12000.0	9.1
SP 59	8ft	80		7.5	12.2	2020.0	420.0	1000.0	29.0	161.0	7200.0	12.2
SP 60	9ft	77	water @ 9ft	7.5	12.1	2005.0	415.0	950.0	30.0	165.0	8020.0	12.4
SP 61	9-10ft	72		7.5	13.2	2185.0	430.0	1100.0	33.0	185.0	9200.0	12.7
SP 62	10-12 ft	76		7.6	13.9	2285.0	415.0	1200.0	35.0	320.0	8600.0	12.9
Hole #5 Forman												
SP 63	0 to 1ft	80		7.2	24.7	5150.0	455.0	2600.0	35.0	950.0	16400.0	20.6
SP 64	2ft	80		8.1	14.2	3250.0	415.0	650.0	13.0	370.0	7600.0	23.2
SP 65	3ft	00		8.5	14.2	3350.0	435.0	700.0	20.0	360.0	8000.0	23.1
SP 66	4ft	87		8.3	15.2	3350.0	435.0	900.0	22.0	420.0	8600.0	21.1
SP 67	5ft	92		8.2	17.7	3450.0	445.0	1900.0	30.0	400.0	11200.0	15.9
SP 68	6ft	71		8.0	15.9	2425.0	430.0	1700.0	35.0	330.0	10200.0	11.7
SP 69	7ft	97	CL (sandy) water @ 8ft	7.8	13.4	1960.0	435.0	1400.0	35.0	160.0	7800.0	10.3
SP 70	8ft	76		7.7	9.2	1210.0	455.0	800.0	37.0	150.0	4600.0	7.9
SP 71	8-9ft	65		7.6	7.8	955.0	460.0	650.0	43.0	105.0	3600.0	6.7
SP 72	9-11ft	98		7.3	7.8	860.0	450.0	550.0	48.0	68.0	3600.0	6.4
SP 73	11-14 ft	78		7.4	7.8	1000.0	440.0	600.0	44.0	101.0	3600.0	7.8

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TABLE 2

Fig. 8

FORMAN SITE NW17 - 13 - 25 - W2

CROPPING PLAN

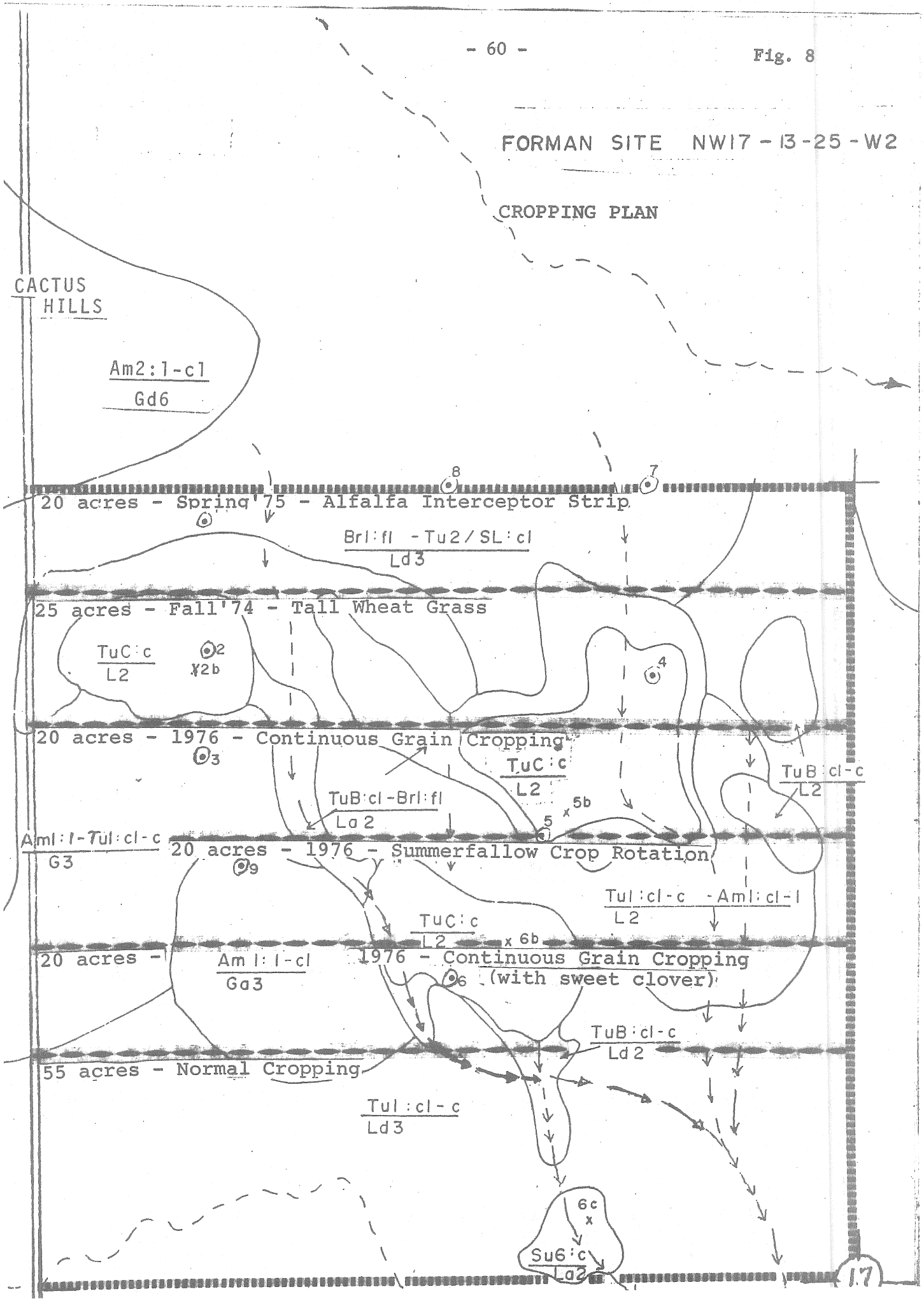

Fig. 9

CROP SALINITY TOLERANCE TEST

Objective - to demonstrate relative tolerance of various crops to soil salinity as measured by:

a) seedling emergence
b) portion of stand reaching maturity
c) plant height) allowing for inherent
total plant yield) species differences

The 1975 tests included 13 plant types replicated 4 times (as indicated below) in 3 soil zones. Plantings were in 10 foot rows (100 seeds) allowing 1 foot between rows, 4 foot borders and 4 feet between replicates.

One such test was in wet saline area on the Lowe farm, SE of Moose Jaw (SE 26-14-26 W2) in the Dark Brown soil zone. This field was wet during seeding on June 5. A moderate weed infestation was hand weeded out on July 9.

1	2	3
Tempest buckwheat	Sugar beets	Harmon oats	Hector barley
Zephyr rapeseed	Chilean lentils	Tempest buckwheat	Krasnodarets sunflower
R 500 rapeseed	Zephyr rapeseed	Macoun durum	Pitic wheat
Harmon oats	Dufferin flax	Zephyr rapeseed	Napayo wheat
Hector barley	R 500 rapeseed	Yellow mustard	Tempest buckwheat
Dufferin flax	Pitic wheat	Sugar beets	Sugar beets
Yellow mustard	Tempest buckwheat	R 500 rapeseed	Chilean lentils
Sugar beet	Hector barley	Chilean lentils	R 500 rapeseed
Pitic wheat	Krasnodarets sunflower	Hector barley	Dufferin flax
Macoun durum	Harmon oats	Dufferin flax	Macoun durum
Chilean lentils	Yellow mustard	Pitic wheat	Zephyr rapeseed
Krasnodarets sunflower	Macoun durum	Napayo wheat	Harmon oats
Napayo wheat	Napayo wheat	Krasnodarets sunflower	Yellow mustard

Fall 1975 salinity levels of border strips 1, 2, 3 expressed in mmhos./cm. using a 1:1 extract:

0 - 6" depth	3.2	5.0	5.0
6 - 12" depth	2.3	3.1	4.1
12 - 24" depth	1.0	3.1	3.0

Composite of 40 samples taken throughout plot (mmhos/cm):

surface half-inch	8.6
0 - 2" depth	6.5
2 - 4" depth	5.1

		TEMPEST BUCKWHEAT	ZEPHYR RAPESEED	R 500 RAPESEED	HARMON OATS	HECTOR BARLEY	DUFFERIN FLAX	YELLOW MUSTARD	SUGAR BEET	PITIC WHEAT	MACOUN DURUM	CHILEAN LENTILS	KRASNODARETS SUNFLOWERS	NAPAYO WHEAT
% ermin- ation	R1	68	12	23	69	80	8	21	77	66	59	28	90	87
	R2	51	10	16	72	89	26	18	133	51	60	40	90	73
	R3	68	38	29	88	80	8	21	133	49	65	47	85	56
	R4	14	1	49	76	88	40	1	93	53	36	25	93	85
Mean		50.2	15.2	29.2	76.2	84.2	20.5	15.2	104	54.7	55	35	89.5	75.2
ating 1-10) uly	R1	8	4	5	8	8	3	4	4	7	6	3	9	6
	R2	7	1	1	9	9	3	4	6	5	5	5	9	6
	R3	7	5	4	8	8	1	6	5	4	6	7	9	4
	R4	0	-	9	6	7	6	-	3	4	2	2	8	6
Mean		5.5	2.5	4.7	7.7	8.0	3.2	3.5	4.5	5.0	4.7	4.2	8.7	5.5
ating 1-10) ovember	R1	6	4	2	8	7	6	4	7	6	4	4	8	3
	R2	7	2	1	8	7	6	4	9	7	5	4	8	5
	R3	7	4	3	9	6	4	4	8	3	4	4	8	2
	R4	0	-	6	7	7	6	-	8	2	-	4	8	3
Mean		5.0	2.5	3.0	8.0	6.7	5.5	3.0	8.0	4.5	3.2	4	8	3.2
% ormal eight (1)	R1	42	44	22	147	108	84	89	100	79	76	75	65	47
	R2	56	33	22	120	100	84	67	156	64	62	67	65	63
	R3	54	50	19	120	88	105	56	100	50	72	83	65	47
	R4	-	-	44	93	92	89	-	89	43	-	83	73	50
Mean		38	31.7	26.7	120	97	90.5	53	111.2	59	52.5	77	67	51.7
ield per lot (grams) (2)	R1	11	4	-	287	402	3	24	965	256	106	1	275	22
	R2	3	1	-	290	300	7	15	1157	73	31	4	316	31
	R3	21	20	-	415	218	4	24	1080	4	18	29	359	3
	R4	-	-	4	103	155	14	-	860	2	-	3	333	13
Mean		8.75	6.25	1	273.75	268.75	7.0	15.75	1015.50	83.75	38.75	9.25	320.75	17.25
ield per lant (grams) (2)	R1	.28	.33	-	4.16	5.15	.38	1.14	41.96	4.06	2.12	.04	27.5	.26
	R2	.10	.10	-	4.03	3.45	.27	.83	28.93	1.52	.61	.11	31.6	.43
	R3	.54	.54	-	4.72	2.79	.50	1.14	31.76	.09	.33	.67	35.9	.05
	R4	-	-	.08	1.36	1.80	.35	-	30.71	.04	-	.13	33.3	.16
Mean		.23	.24	.02	3.57	3.30	.38	.78	33.29	1.43	.77	.24	32.08	.23

(1) Normal heights are considered as average heights of plants as reported in crop variety trials.

(2) All yields except sugar beets are reported on an air dry basis. Sugar beet yields are oven dry tuber weight.

Table 3

Appendix A

SOIL SALINITY DEMONSTRATION

FORMAN SITE NW17-13-25 W2

H.P.W. Rostad and N.W. Moore

SOILS OF THE MAP AREA

The soils of the area are developed on a wide variety of parent materials. The Cactus Hills just west of the area are composed of moderately fine textured glacial till with inclusions of large blocks of Tertiary bedrock. Erosion from the hills during and after glacietion has caused the deposition of clays, sands and gravels over various portions of the map area.

The most common subgroup profiles are the Dark Brown Solonetz and Dark Brown Orthic Chernozem. The clay textured soils tend to be dominantly Solonetz while the lighter textured soils are mostly Chernozemic. The salt affected soils range from slightly saline and carbonated solonetzic and chernozemic to strongly saline solonetzic, chernozemic and regosolic soils.

SALINE SOILS

The condition of the 1974 crop was used as an indicator of the degree of salinity. The crop stubble varied from none to sparse and moderate stubble.

1. Soils with no crop stubble

The soils in these areas are dominantly clay textured and in some cases have a white crust of precipitated salts on the surface. This area was mapped as Tu:C: c or Tuxford association map unit C and clay texture. The soils varied from moist to very wet.

2. Soils with moderate salinity

In general these soils were associated with the strongly saline soils as a rim around the bare area or as extensions of the strongly saline areas along minor drainage ways. The texture of the soils varied from clay to sand. The sand along the drainage ways was a result of recent erosion and deposition while the sand in the rim around the bare spot is a result of glaciation.

NON-SALINE SOILS

1. Solonetzic

The dominant series occurring in the Solonetzic order was the Solonetz. It occurred most often in the clay textured material. Along the northern part of the field, the clay solonetz profile was 10-18" thick over sand, while further south the clay material was dominantly greater than three feet thick. There were minor amounts of weak solonetz profiles occurring on the till material.

2. Chernozemic

The chernozemic soils occurred on the upland till areas and on some of the lower sandy materials.

DESCRIPTION OF THE MAP AREA

There are three major saline areas occurring on this quarter section. In some cases the salinity is so severe that a ¼ inch crust of salt has formed on the surface. Parts of the saline areas are very wet.

There are small streams entering the field from the upland to the north. It appears that the streams enter the saline areas from the north and leave out the south end. A detailed topographic survey will be necessary to definitely ascertain the direction of surface water flow. There is a large slough area (Su6:C) that does not appear to be saline. The soil materials are similar to the saline areas. There is varying depths of sand occuring north and upslope of the saline areas. It is possible that water infiltrates in the sand and discharges downslope. The Cactus Hills to the north west could also be providing the hydraulic head necessary to cause discharge of saline groundwater. The surface water coming out of the hills may have more than average amounts of salts present due to the large blocks of Tertiary bedrock at higher elevations.

SHALLOW SOIL SAMPLES

Site 2b. In the centre of a bare area near hole #2 drilled by the truck. The surface is white with salts.

2b-1	0 - 6"	
2b-2	6 - 12")	
2b-3	12 - 18")	$CO_3^=$ present, very wet and sticky clay
2b-4	18 - 24")	

Site 5b. The south or downstream edge of large saline area. Thick white salt crust on the surface.

5b-1	0 - 6"	black clay, low carbonates
5b-2	6 - 12")	
5b-3	12 - 18")	$CO_3^=$ present
5b-4	18 - 24")	
5b-5	salt crust	

Site 6b. The NE or upside of a saline area, no overland connection to Site 5.

6b-1	0 - 6"
6b-2	6 - 12"
6b-3	12 - 18"
6b-4	18 - 24"
6b-5	salt crust

Site 6c. South of 6b, had a good oats crop, appeared to be non-saline. Heavy firm black clay.

6c-1	0 - 6"
6c-2	6 - 12"
6c-3	12 - 18"
6c-4	18 - 24"

DEEP SOIL SAMPLES

These samples were taken with a 12 inch auger. The samples were taken and described by Art Bristol. In most cases a samples was taken every foot.

Hole #1

Depth (feet)	Material	Samples	Remarks
0 - 2	CL-C	Sp1-2	
2 - 3	C (sand lens)	Sp3	
3 - 5	C	Sp4-5	
5 - 7	FL	Sp6-7	saturated with water
7 - 9	Cl till	Sp8-9	
9 - 15	CL till	Sp10-15	gypsum, iron staining

Water level at 99" 45 minutes later, sample taken.

Hole #2

0 4	CL-C	Sp16-19	
4 - 12	CL till	Sp20-27	gypsum, iron staining

Water level at 90", still rising, sample taken.

Hole #3

0 - 3	CL till (gravelly)	Sp28-30	
3 - 4	Heavy CL till	Sp31	gypsum, iron staining
4 - 15	Heavy CL till	Sp32-40	dark coloured till

No water.

Hole #4

0 - 4	CL	Sp41-44	
4 - 6	CL till	Sp45-46	
6 - 9	CL till	Sp47-49	saturated with water
9 - 15	CL till	Sp50-51	

Hole had caved in 3 feet from the surface, water sample taken at 2.5 foot level.

Hole #5

0 - 5	Heavy CL	Sp52-56	
5 - 12	Heavy CL till	Sp57-62	gypsum, dark iron staining

Water level at 9 feet, sample taken.

Hole #6

0 - 7	C	Sp63-69	
7 - 8	CL (sandy)	Sp70	water bearing
8 - 13	C till	Sp71-73	lacustrine like

Water level at 8 feet, sample taken.

Hole #7

CL till (except water saturated SCL 2 to 7 feet). Water level at 10 feet, sample taken. No soil samples taken.

Hole #8

L-CL 0 to 2 feet then gravel to 22 feet. 8 to 22 feet saturated with water.
No soil samples taken.

Hole #9

Gravelly till 0 to 5 feet. Black massive clay till 5 to 14 feet.
No soil samples taken.